

**CLEAN COPY OF PAGE 1**

a!

Illumination Method, Illumination System and the Components Thereof, Especially for Illuminating Hollow Bodies such as Signs, Inscriptions, Letters, Especially Relief Letters and the Like as well as a Sign, An Inscription and a Letter, Especially Relief Letter with Illumination

**Background of the Invention**

The invention relates to a lighting method, lighting system and its components, in particular for illuminating hollow elements such as signs, inscriptions, letters, in particular relief letters and the like, and a sign, inscription, letter, in particular a relief letter with illumination means.

When hollow elements such as signs, inscriptions, letters and in particular relief letters such as are used, for example, in outdoor advertising are illuminated, there is the problem of illuminating the respective hollow element, that is to say a relief letter for example, in a uniform way. Such relief letters are usually made up of a housing for accommodating lighting means such as tubular lamps and a translucent, usually colored housing cover in the form of the letter. It is to be noted here that the term "relief letter" is to be understood as referring to all types of internally illuminated, three-dimensional letters, numerals, characters and logos, that is to say not only to the 26 letters of the Latin alphabet.

In particular in the case of relief letters, uniform illumination is not a minor technical lighting problem if the letters are to be easily readable even from a distance. If the illumination is not uniform, it is possible, for

## CLEAN COPY OF PAGE 3

a2  
a Y presents further problems if the illumination is to be uniform. Although LED technology has a range of fundamental advantages over tubular lamps, for this reason LED tubes have not been able to gain acceptance in practice particularly with letters.

## Summary of the Invention

Taking the above as a starting off point, the invention is based on the object of specifying a lighting method and a lighting system which permit the advantages of LED technology to be used even when solving complicated illumination problems, such as the illumination of relief letters.

The object is achieved on the one hand by a system, in particular for illuminating hollow elements such as signs, inscriptions, letters, in particular relief letters and the like, comprising a number of printed circuit boards provided with LEDs, cables for connecting the printed circuit boards to one another and/or for connecting the printed circuit boards to a voltage source, attachment elements for attaching the printed circuit boards to a desired location. The system has a range of considerable advantages: it can be retrofitted, can be used universally, requires only a few different components, does not require any high voltage and is easy to mount.

As a result of the use of the technology according to the invention, it is also possible to replace the tubular lamps in already existing inscriptions and letters. In this way the power consumption can be reduced by 90%.

The service life of the LEDs is up to 100,000 hours.

They are fully recyclable and are manufactured in an environmentally friendly way.

Further advantages are:

Less hazardous handling during maintenance and mounting procedures as a result of 12 Volt technology (neon tubes operate at high voltage of 6000 Volts and higher) which also results in a different

**CLEAN COPY OF PAGE 8**

23  
lines, the distance between the two lines being approximately 25 to 35 mm and the distance between two adjacent LEDs arranged on a line being approximately 30 to 40 mm.

The printed circuit board is approximately 140 to 160 mm long, approximately 32 to 42 mm wide and approximately 1 to 3 mm thick.

An opening for an attachment element for attaching the printed circuit board is provided.

At least two connecting points each with a positive lead and a negative lead for current are provided, each connecting point being designed for the connection of standardized plugs.

A guide groove for guiding a plug is provided in the vicinity of each connecting point.

A corresponding element which is at least partially complementary to a latching element of a plug, in particular a mounting opening, is provided in the vicinity of each connecting point.

## CLEAN COPY OF PAGE 9

24  
The plug for a system according to the invention is designed in such a way that a plug which is connected to a connecting point of a printed circuit board protects the positive and negative leads against moisture.

The plug has a latching element which, after the plug has been fitted onto a printed circuit board, latches with a corresponding element provided for that purpose on the printed circuit boards.

An attachment element for a system according to the invention has a self-adhesive film on one flat side of the attachment element.

An attachment element for a system according to the invention has at least one bearing surface for a printed circuit board and a mounting element which latches to the printed circuit board and presses the printed circuit board against the bearing surface are provided.

A power supply system for a system according to the invention has a DEAD-OFF module which terminates the life of the power supply unit if overheating by a predefined limiting value occurs.

The power supply unit for a system according to the invention is vacuum sealed and suitable for external use.

## CLEAN COPY OF PAGE 10

2  
A solar module for a system according to the invention has a buffer battery and a voltage monitor.

A control module for a system according to the invention is configured such that the lighting system is automatically switched on or off when predefinable peripheral conditions occur, for example times or brightness levels.

A regulating module for a system according to the invention is designed for the selective regulation of the power supply of individual printed circuit boards and/or individual LEDs on the printed circuit boards.

A sign, inscription, letter, in particular relief letter with illumination means, is configured such that the illumination is powered by means of a system or parts of a system according to the invention.

The system or parts of a system according to the invention are used for illuminating a sign, inscription or a letter, in particular a relief letter.

According to the lighting method of the invention, in particular for illuminating hollow elements such as signs, inscriptions, letters, in particular relief letters and the like, a number of printed circuit boards provided with LEDs are connected to one another and/or to a voltage source by means of cables, and the printed circuit boards are

## CLEAN COPY OF PAGE 11

attached to a desired location by means of attachment elements.

## Brief Description of the Drawings

Further details and advantages of the invention are to be found in the following description of a number of purely exemplary and nonrestrictive exemplary embodiments, in conjunction with the drawing, in which:

Fig. 1 shows a printed circuit board according to the invention with three LEDs in a plan view,

Fig. 2 shows the printed circuit board according to Fig. 1 in a side view,

Fig. 3 shows a printed circuit board according to the invention with six LEDs in a plan view,

Fig. 4 shows the printed circuit board according to Fig. 3 in a side view,

Fig. 5 shows a printed circuit board according to the invention with nine LEDs in a plan view,

Fig. 6 shows the printed circuit board according to Fig. 5 in a side view,

Fig. 7 shows an attachment element for attaching a printed circuit board in a plan view,

Fig. 8 shows the attachment element according to according to Fig. 7 in a side view;

Fig. 9 shows the inner side of a first relief letter;

Fig. 10 shows the inner side of a second relief letter; and

Fig. 11 shows the inner side of a third relief letter.

## Description of Preferred Embodiments

Figures 1 to 6 show three different exemplary embodiments of the printed circuit boards 10, 30 and 50 according to the invention, which differ in the number of respectively provided LEDs and protective resistors and in the dimensions, but have the same basic design so that these three exemplary embodiments are described together in order to avoid repetitions.

## CLEAN COPY OF PAGE 13

27  
provided on a corresponding plug so that a plug which is fitted on is advantageously secured against slipping down.

As is clear from Figures 1 to 6, the wiring of the LEDs is failsafe: if an LED in a group of three fails, the entire group of three is "dead", but this does not affect the other LED groups provided on the printed circuit board nor printed circuit boards connected in series with the affected printed circuit board.

In Figures 7 and 8, an attachment element, designated in its entirety by 90, for a printed circuit board is shown, in which attachment element two supporting plungers 94 which each form a bearing surface for a printed circuit board on a supporting plate 92 and a mounting element 96 which latches to the printed circuit board and presses the printed circuit board against the bearing surface are provided. Latching projections 100 corresponding to the latching element are formed on the latching element which is divided in two here. An adhesive strip 98, by means of which the mounting element can be particularly easily attached, for example in a relief letter, is provided under the supporting plate 92.

Figures 9 to 11 show the inside of the housing rear wall of three different relief letters with different heights, onto which inside printed circuit boards are adhesively bonded in a manner according to the invention.